CHAPTER 10

ATA and ATAPI

This chapter presents the requirements and recommendations for ATA (AT Attachment), ATAPI (ATA Packet Interface) controllers and peripherals. ATA—also known as IDE (Integrated Device Electronics)—is one of the most widely used interfaces in the PC world.

The use of ATA in a PC 99 system is optional. If ATA is used, however, all components must comply with the requirements defined in this chapter.

Contents

ATA Controller Requirements

This section summarizes the specifications and standards for Windows-compatible ATA controllers.

10.1. Controller and peripherals comply with ATA-2, ATA-3, or ATA/ATAPI-4 standards

Required

All ATA/ATAPI controllers and peripherals must meet the hardware and software design requirements listed in the ATA-2, ATA-3, or ATA/ATAPI-4 Revision 17 or later standard.

Storage subsystems that require advanced features such as command queuing should use IEEE 1394 for the storage interface.

10.2. Bootable ATA controller supports El Torito No Emulation mode

Required

A bootable ATA storage controller must support the No Emulation mode defined in *El Torito—Bootable CD-ROM Format Specification, Version 1.0*, or an equivalent method that supports the Windows 2000 Professional CD-ROM installation process.

10.3. Option ROMs support Int 13h Extensions

Required

PC 99A clarification: This requirement also applies for RAID controllers implemented on client systems such as workstations.

The Int 13h Extensions ensure correct support for high-capacity drives, consistent drive-letter mapping between real mode and protected mode, and other capabilities for both Windows 98 and Windows 2000 operating systems. Support for the fixed-disk access subset of Int 13h Extensions must be provided in the system BIOS and in any option ROMs for storage devices that include BIOS support.

The system BIOS must support the use of logical block addressing (LBA) for drives with LBA addressable area greater than 16,515,072 sectors. Support for drives with capacities greater than 8.4 GB must be provided through the extended services (functions 4xh and greater) of the Int 13h Extensions as defined in *Information Technology Enhanced BIOS Services for Disk Drives [T13-1226DT], Revision 7*, available at ftp://fission.dt.wdc.com/pub/standards/x3t13/project/.

The Int 13h Extensions are defined in the “Layered Block Device Drivers” section of the Windows 95 DDK and in the Windows 2000 DDK.

PC 99A clarification: The Int 13h Extensions are defined in “Chapter 14: Int 13 Extension APIs” in the “Storage Technology Reference” in the Windows 95 DDK (included with the Windows 98 DDK and available online at http://www.microsoft.com/ddk/ddkdocs/win98ddk/storage_60q9.htm).

10.4. Dual ATA adapters use single FIFO with asynchronous access or dual FIFOs and channels

Required

Although the use of an ATA adapter with more than one channel is optional, if included, dual ATA adapters must be designed so that either channel might be used at any time; the operating system does not have to serialize access between the primary and secondary channel. This means either that the two channels are totally independent or that anything shared, such as a programmed I/O (PIO) read pre-fetch buffer, is protected by a hardware arbitrator.

Section 5.0 of the *Compaq, Intel, Phoenix BIOS Boot Specification* defines an implementation for dual asynchronous channels. This specification is available at http://www.ptltd.com/techs/specs.html.

A design implementing a single first in/first out (FIFO) that uses a hardware solution to synchronize access to both channels meets this requirement if the design does not require that a request on one channel be completed before another can be started. A software-based solution is not acceptable.

Dual-channel controllers that require special software to serialize channel I/O for a single prefetch FIFO do not meet these requirements. Such designs require serial access to one of four devices, defeating the primary advantage of asynchronous dual-channel controllers. Furthermore, such devices are non-standard and require custom driver support.

10.5. System BIOS and devices support LBA

Required

To enable support for ATA disk drives that have capacities greater than 528 MB (1,030,176 logical blocks), the system BIOS must use LBA for all read and write operations to the device. The LBA bit in the Device/Head register must be set to one. The ATA 1226 technical report defines the proper implementation of LBA.

Although ATAPI was defined to be transparent to the BIOS, the BIOS must recognize the presence of ATAPI devices using the signature defined in SFF 8020i.

10.6. System BIOS supports ARMD

Recommended

The system BIOS or option ROM should provide boot support for the primary ATAPI bootable floppy disk drive in compliance with *ATAPI Removable Media BIOS Specification (ARMD), Version 1.0* or later. Complying with this specification provides Int 13h and Int 40h support for bootable floppy drives as the primary or secondary floppy device.

10.7. Controller and peripherals support Ultra DMA

Required

The programming register set for PCI IDE bus master direct memory access (DMA) is defined in ATA-4 or SFF 8038i. ATA drives must comply with ATA-4 to ensure fully featured hardware and Windows-compatible device driver support.

All controllers and ATA hard drive peripherals must support Ultra DMA at transfer rates up to 33 MB per second as defined in ATA/ATAPI-4 Revision 17. In addition to improved transfer rates, Ultra DMA also provides error checking for improved robustness over previous ATA implementations. PCI chip sets must implement DMA as defined in SFF 8038i.

Ultra DMA is only recommended for ATAPI devices. If a device does not support the Ultra DMA transfer protocol, it must, at a minimum, implement the termination scheme required by this protocol to ensure that all devices coexist with Ultra DMA devices.

PC 99A correction: ATA and ATAPI devices must meet the following support requirements and recommendations for Ultra DMA and IDE Bus Master DMA.

Support for Ultra DMA:

- Required for ATA controllers and ATA devices
- Recommended for ATAPI peripherals

  However, ATAPI devices might be connected to the ATA bus (which is required to support UDMA). Therefore, to ensure that ATAPI devices will tolerate Ultra DMA, ATAPI devices must support the termination scheme as defined in ATA/ATAPI-4 or SFF 8038i.

Support for IDE Bus Master DMA:

- Required for ATA controllers
- Required for ATA devices and ATAPI peripherals, including CD and DVD devices
- Recommended for ATA/ATAPI tape drives
- Recommended for ATAPI removable media drives

The system BIOS should configure the drive and host controller, optimized for Ultra DMA operation if possible, however, programmed I/O (PIO) mode must continue to work. The ACPI software should also support the restoration of these settings in ACPI control methods _GTM, _STM, and _GTF, for which there are no standard registers, if the controller loses timing context across a suspend and resume cycle. The BIOS pre-operating system boot disk services, (INT13h read and write) need not actually use Ultra DMA for access of the drive prior to operating system boot.

Definitions for the above ACPI control methods can be found in Section 5 of the *Advanced Configuration and Power Interface Specification, Revision 1.0* or later, with consideration of the ACPI errata available on the web site at http://www.teleport.com/~acpi/tech.htm.

10.8. Controller and peripheral connections include Pin 1 cable designation with keyed and shrouded connectors

Required

Pin 1 orientation must be designated by one edge of the keyed ribbon cable and also on the keyed connector of the ATA or ATAPI controller and peripheral device. Designation of the keyed connector must be clearly indicated on or near the connector.

ATAPI Peripheral General Requirements

This section defines the requirements for all ATAPI devices. Specific requirements for floppy drives, hard drives, CD drives, and DVD drives are defined in Chapter 18, “Storage and Related Peripherals.”

10.9. Peripherals comply with ATA/ATAPI-4 or SFF 8020i v.2.5

Required

The ATA/ATAPI-4 standard defines hardware and software design guidelines for ATAPI devices. The operating system also supports enumeration based on SFF 8020i, Version 2.5 or later.

See also requirement 10.3, “Option ROMs support Int 13h Extensions.”

10.10. Removable media devices support media status notification

Required

Removable media storage devices must support media status notification as specified in requirement 18.2, “Removable media devices support media status notification.”

PC 99A note: See the clarifications at item 18.2.

10.11. BIOS enumeration of all ATAPI devices complies with ATA/ATAPI-4 or SFF 8020i v.2.5

Required

The ATA/ATAPI-4 standard defines the enumeration process for all ATAPI devices. The operating system also supports enumeration based on SFF 8020i, Version 2.5 or later.

See also requirement 18.9, “System BIOS or option ROM supports bootable ARMD.”

10.12. ATAPI devices support DEVICE RESET command

Required

ATAPI devices must respond to the DEVICE RESET command regardless of their internal state, as defined in the ATA/ATAPI-4 standard or Section 6.2 of SFF 8020i, Version 2.5 or later. The controller can be reset by going into a power-on state (requests cleared, signature present), but any non-default mode values must be left in their current state with the DRV bit unchanged.

Devices that do not implement the PACKET command feature set, such as hard disk drives, must not implement the DEVICE RESET command.

Plug and Play for ATA Controllers and Peripherals

This section summarizes the Plug and Play requirements for ATA controllers and peripherals.

10.13. Each device has a Plug and Play device ID

Required

For each system-board device there must be a Plug and Play device-specific ID.

Each ATA controller or peripheral device must provide device IDs in the manner required for the bus it uses, as defined in the related chapter for the specific bus in Part 3 of this guide.

For example, an add-on PCI IDE device must comply with PCI 2.1 and also must provide a Subsystem ID and Subsystem Vendor ID as defined in Chapter 9, "PCI." PCI IDE controllers integrated into core logic on the system board do not have to provide Subsystem IDs and Subsystem Vendor IDs, but must meet other PCI 2.1 requirements.

10.14. Dynamic resource configuration is supported for all devices

Required

For ATA controllers and peripheral devices, the system must be capable of automatically assigning, disabling, and relocating the resources used by the device. In the event of an irreconcilable conflict with other devices, the operating system must be able to disable the adapter. Disabling a device must result in freeing all its resources for use by other devices.

The primary hard disk controller is not required to support dynamic disable capabilities.

Configuring or adding a device to the system must not require changing jumpers or switches on either the device or the system board.

Note: This requirement does not apply to jumper settings used by the OEM to make basic system-related settings in the factory. This requirement applies only to settings that the end user must make to configure the hardware.

10.15. Resource configuration meets bus requirements

Required

Plug and Play resource configuration requirements are defined by the bus used by the ATA/ATAPI controllers and peripheral devices, as defined in the related chapter for the specific bus in Part 3 of this guide.

10.16. ISA address ranges 3F7h and 377h are not claimed by ATA controllers

Required

Although ATA controllers might use these addresses, 3F7h and 377h also contain registers used by the FDC. To prevent resource conflicts, these addresses must not be claimed as device-register resources.

Power Management for ATA Devices

This section summarizes the specific ATA power management requirements. Power management requirements for peripherals that use ATA are defined in the related device-class chapters in Part 4 of this guide.

10.17. Bus and device meet PC 99 power management requirements

Required

The ATA channel must comply with the *Storage Device Class Power Management Reference Specification, Version 1.0* or later. Additional power management requirements are specified based on industry-defined standards for the bus used by the controller, such as PCI, and for the device. For more information, see the related chapter for the specific bus in Part 3 of this guide.

The ability to cause a wake-up event as defined in *Storage Device Class Power Management Reference Specification* is an optional feature.

10.18. ATA device supports ATA STANDBY command

Required

ATA drives must implement the ATA STANDBY command as defined in the ATA/ATAPI-4 standard or SFF 8020i.

For mobile ATA drives, it is recommended that a Read operation typically be completed within 5 seconds of applying power or leaving ATA STANDBY mode and transitioning to ATA ACTIVE. For desktop systems, the recommendation is 10 seconds. Information on system power states and transitions can be found in *Storage Device Class Power Management Reference Specification, Version 1.0* or later.

The drive spinup time recommendation is not expected to become a requirement in future versions of this guide.

ATA and ATAPI References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

Advanced Configuration and Power Interface Specification, Revision 1.0 and later
http://www.teleport.com/~acpi/tech.htm.

AT Attachment 2 [X3T9.2 948D] and *AT Attachment 3* [X3T10 2008D] standards
ATA/ATAPI-4 Revision 17 Working Draft Standard (ATA/ATAPI-4)
ATA Packet Interface for CD-ROM (SFF 8020i)
Other ATA standards
Global Engineering Documents
Fax: (303) 397-2740
Phone: (800) 854-7179 (U.S.)
(613) 237-4250 (Canada)
(303) 792-2181 (Outside North America)

ATA and ATAPI draft standards and other working documents are available at
ftp://fission.dt.wdc.com/pub/standards/ and
ftp://ftp.symbios.com/pub/standards/io/

Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01
http://www.ptltd.com/techs/specs.html
http://www.microsoft.com/hwdev/respec/pnpspecs.htm
El Torito—Bootable CD-ROM Format Specification, Version 1.0
http://www.ptltd.com/techs/specs.html

Media Status Notification Support Specification, Version 1.03
http://msdn.microsoft.com/library/specs/atamed.htm
http://www.microsoft.com/HWDev/respec/storspec.htm

Microsoft Windows 98 DDK, Windows 2000 DDK, and DirectX 5.0 DDK
http://www.microsoft.com/ddk/
(or MSDN Professional subscription)

MMC-2 Multi-Media Command Set-2
ftp://ftp.symbios.com/pub/standards/io/t10/drafts/mmc2/

PCI Local Bus Specification, Revision 2.1 (PCI 2.1) and later
PCI SIG
Phone: (800) 433-5177
http://www.pcisig.com/specs.html

SFF 8090 (Mt. Fuji specification)
Other SFF Committee publications and specifications
FaxAccess: (408) 741-1600 (fax-back)
Fax: (408) 867-2115
ftp://fission.dt.wdc.com/pub/standards/SFF/specs/

Storage Device Class Power Management Reference Specification, Version 1.0
http://www.microsoft.com/hwdev/specs/PMref/PMstore.htm

White papers and guidelines for Microsoft operating systems
http://www.microsoft.com/hwdev/storage/

Checklist for ATA and ATAPI

If a recommended feature is implemented, it must meet the requirements for that feature as defined in this document.

10.1. Controller and peripherals comply with ATA-2, ATA-3, or ATA/ATAPI-4 standards
Required

10.2. Bootable ATA controller supports El Torito No Emulation mode
Required

10.3. Option ROMs support Int 13h Extensions
Required

10.4. Dual ATA adapters use single FIFO with asynchronous access or dual FIFOs and channels
Required

10.5. System BIOS and devices support LBA
Required

10.6. System BIOS supports ARMD
Recommended

10.7. Controller and peripherals support Ultra DMA
Required

10.8. Controller and peripheral connections include Pin 1 cable designation with keyed and shrouded connectors
Required

10.9. Peripherals comply with ATA/ATAPI-4 or SFF 8020i v.2.5
Required

10.10. Removable media devices support media status notification
Required

10.11. BIOS enumeration of all ATAPI devices complies with ATA/ATAPI-4 or SFF 8020i v.2.5
Required

10.12. ATAPI devices support DEVICE RESET command
Required

10.13. Each device has a Plug and Play device ID
Required

10.14. Dynamic resource configuration is supported for all devices
Required

10.15. Resource configuration meets bus requirements
Required

10.16. ISA address ranges 3F7h and 377h are not claimed by ATA controllers
Required

10.17. Bus and device meet PC 99 power management requirements
Required

10.18. ATA device supports ATA STANDBY command
Required